

## Appendix A

### Technical Details

If  $X_1, X_2, \dots, X_n$  are iid  $N(\mu, \sigma^2)$  then  $\bar{X}$  is  $N(\mu, \sigma^2/n)$  and the margin of error for  $\bar{X}$  is approximately  $1.96\sigma^2/n$  when  $n$  is large.

For a normal distribution we expect 95% of the observations to be between  $\mu - 1.96\sigma$  and  $\mu + 1.96\sigma$ . With data, these bounds are estimated by  $\bar{X} - 1.96s$  and  $\bar{X} + 1.96s$ , respectively.

Under the normal assumption,  $\bar{X}$  and  $s$  are independent, so  $\text{var}(\bar{X} \pm 1.96s) = \text{var}(\bar{X}) + 1.96^2 \text{var}(s)$ . Also, under the normal assumption,  $(n-1)s^2/\sigma^2$  is distributed as  $\chi_{n-1}^2$ . Therefore,  $\text{var}(s)$  is approximately  $\sigma^2/(2(n-1))$  and  $\text{var}(\bar{X} \pm 1.96s)$  is approximately  $3\sigma^2/(n-1)$ , and the margins of error for  $\bar{X} - 1.96s$  and  $\bar{X} + 1.96s$  are both  $\sigma\sqrt{3/(n-1)}$ . For a 50% coefficient of variation,  $\sigma = 0.5\mu$  and the margin of error for the estimates is  $\mu\sqrt{3/(n-1)}$ .

For  $n = 500$  and  $\mu = 5$ , the margin of error is 0.39; for  $n = 500$  and  $\mu = 0.5$ , the margin of error is 0.039. These results have been verified by simulation.